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10/772,253	02/06/2004	Mitsushi Fujiki	042068	6491

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EXAMINER	
PHAM, THANH V	
ART UNIT	**PAPER NUMBER**
2823	

DATE MAILED: 07/13/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/772,253	FUJIKI, MITSUSHI	
	Examiner	Art Unit	
	Thanh V. Pham	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 June 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-10* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Claims 1-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Corvasce et al. US 6,300,654 B1 in combination with Sasaki et al. US 6,444,099 B1, and further in view of Matsuura et al. US 6,964,873 B2, Ohwaki et al., "Preferred Orientation in Ti Film Sputter-Deposited on SiO_2 Glass: The Role of Water Chemisorption on the Substrate", Jpn. J. Appl. Phys., Vol. 36 (1997) pp L154-L157 (provided by applicant) and Noguchi et al. US 6,716,749 B2.

3. *Re claim 1*, the Corvasce et al. reference discloses a method of manufacturing a semiconductor device of prior art, comprising:

forming an insulating film 24 over a semiconductor substrate 11; forming a Ti lower layer 26 of a lower-electrode conductive film on the insulating film 24;

forming an upper layer 7 of the lower-electrode conductive film on the lower layer 26, and constituting a lower-electrode conductive film by the upper and lower layers;

forming a ferroelectric film 17 of PZT or SBT (re claim 7) on the lower-electrode conductive film 7/26;

forming an upper-electrode conductive film 8 on the ferroelectric film 17; and

forming a ferroelectric capacitor by patterning the upper-electrode conductive film, the ferroelectric film, and the lower-electrode conductive film, fig. 3.

The Corvasce et al. reference does not disclose *what method in what temperature used in the process step of forming lower layer of lower-electrode conductive film. In other words*, the Corvasce et al. reference does not disclose keeping substrate temperature higher than room temperature and lower than 300 ^{O}C while forming a Ti lower layer 26 of a lower-electrode conductive film on the insulating film 24.

The Sasaki et al. reference discloses, col. 6, line 65 – col. 7, line 30

EXAMPLE 1
Sputtering can be carried out under the following conditions as a practical example (hereinafter referred to as the first practical example) of producing a titanium thin film for use as a barrier film. This example pertains to the embodiment given above.

Sputtering power source 3: 13.56 MHz, 8 kW output
Material of target 2: titanium
Type of process gas: argon
Flux of process gas: 120 cc/min
Pressure during film deposition: 60 mTorr
Substrate-biasing voltage: -600 V
Temperature of substrate holder 5 during film deposition: 300.degree. C.
Deposition rate: 500 angstroms/min

EXAMPLE 2:
Sputtering can be carried out under the following conditions as a practical example (hereinafter referred to as the second practical example) of producing a titanium nitride thin film for use as a barrier film.

Sputtering power source 3: 13.56 MHz, 8 kW output
Material of target 2: titanium
Type of process gas: mixed gas of argon and nitrogen
Flux of process gas: argon 25 cc/min; nitrogen 75 cc/min
Pressure during film deposition: 45 mTorr
Substrate-biasing voltage: -600 V
Temperature of substrate holder 5 during film deposition: 200.degree. C.
Deposition rate: 200 angstroms/min

It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the method in Corvasce et al. with the Ti sputtering while keeping substrate temperature higher than room temperature and lower than 300 ^{O}C as taught

by Sasaki et al. <u>because</u> the Ti sputtering of Sasaki et al. would provide the method of Corvasce et al. with prevention of "a problem with collimation sputtering is that sputter particles accumulate on the collimator portion, and the resulting loss of material decreases the deposition rate" (Sasaki et al.'s col. 2, lines 5-10).

4. <u>The combination does not teach</u> crystal orientation, H_2O added during sputtering, ...

<u>The Marsuura et al. reference discloses</u>, col. 7 lines 34-50 and col. 3 lines 38-52

> Referring to FIG. 3A, a SiO.sub.2 film 32 is formed on a Si substrate 31 by a thermal oxidation process with a thickness of 200 nm, for example, and <u>a lower electrode 33 of **Pt** is formed on the SiO.sub.2 film 32 by a D.C. sputtering process conducted</u> <u>at a room temperature</u>, with an adhesion layer 33A of Ti interposed between the SiO.sub.2 film 32 and the lower electrode 33.
> More specifically, *(re claims 2-3)* <u>the **Ti** adhesion layer 33A is formed</u> in an Ar atmosphere under the pressure of 0.7 Pa with a thickness of about 20 nm as represented in TABLE I below. Further, <u>the lower electrode 33 of Pt is formed under the same condition</u> *(re claim 5)* with a thickness of about 175 nm. The deposition of the Ti film 33A is conducted by setting the D.C. plasma power to 2.6 kW, wherein the deposition of the Ti film 33A is conducted for the duration of 9 seconds while the deposition of the lower electrode 33 is conducted for the duration of 96 seconds while setting the D.C. plasma power to 1.0 kW.
>
> In general, it is known that the ferroelectric properties of a PZT or PLZT film is related to the orientation of the PZT or PLZT crystals constituting the film. Commonly, a predominantly (111) or (100)-orientation is obtained for a PZT or PLZT film formed on <u>a Pt lower electrode, which has a self-textured (111)-orientation</u> *(re claim 6)*, due to the epitaxial effect, in which the surface energy is minimized as a result of the foregoing film orientation. It should be noted that a PZT or PLZT film has a self-textured (100)-orientation. In order to maximize the remnant polarization of the PZT or PLZT film, it is desired to align the PZT of PLZT crystals, which belong to the tetragonal crystal system, such that the switching direction for the preferential (100)-orientation is perpendicular to the switching electric field.
> Meanwhile, it is known that the PZT or PLZT film constituting the ferroelectric capacitor insulation film 16 of FIG. 1 shows a columnar microstructure and that the value of the spontaneous polarization 2 Pr is maximized when the crystal grains therein are oriented in the (111) direction.

The Ohwaki et al. reference discloses a sputtering method (*re claim 2*) for forming Ti (*re claim 3*) on glass which improves the orientation of the Ti film in the preferred (002) direction (*re claim 4*) wherein an orientation with an amount of H_2O (*re claim 10*) to enhance the Ti (002) preferred orientation providing the temperature at 350 ^{O}C.

Choice of temperature, partial pressures of elements would have been a matter of routine optimization because temperature and pressure, among other parameters, are known to mutual affect each other and affect device properties and would depend on the desired device density on the finished wafer and the desired device characteristics. One of ordinary skill in the art would have been led to the recited temperature of higher than room temperature and lower than 300 ^{O}C while forming a Ti lower layer through routine experimentation to achieve desired deposition and reaction rates *as same as in the above combination*. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to provide the method of Corvasce et al.'s prior art with the conditions of Ohwaki et al. and/or Marsuura et al. because the conditions of Ohwaki et al. and/or Marsuura et al. would provide the ferroelectric capacitor of Corvasce et al. with the Ti (002) preferred orientation for the reliability of the electrode (Ohwaki et al.'s) and with better adhesion (Marsuura et al.'s).

5. *Re claim 5*, the Corvasce et al. reference discloses the upper layer of the lower-electrode conductive film is a single-layer film made of platinum, col. 3, line 64.

Marsuura et al.'s PLZT film is formed as the ferroelectric film "by sputtering process contains characteristically low concentration C (carbon)", col. 8, lines 61-63 (*re claim 7*);

an orientation direction of the ferroelectric film 34 is a (111) direction, col. 3, line 39 – col. 4, line 40 and col. 12, lines 10-11 (*re claim 8*); and

"a Pt lower electrode, which has a self-textured (111)-orientation", col. 3, lines 42-43, (the same as instant Background of the Invention, page 2, "in general, a Pt film oriented in the (222) direction, which is the same direction as the (111) direction, is employed as the lower electrode") (*re claim 6*).

6. *Re claim 9*, the combination does not disclose the improvement of the insulating film before forming further the device. The Noguchi et al. reference discloses in col. 21, lines 10-13, quality of the insulating film is improved by exposed a surface of the insulating film to NH_3 plasma. It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the process of the combination with NH_3 plasma nitridation before the lower layer of the lower-electrode conductive film is formed because the plasma nitridation would improve the surface of the insulating film as taught by Noguchi et al.

Response to Arguments

7. Applicant's arguments filed 06/19/2006 have been fully considered but they are not persuasive.

8. In response to the hypothesis on page 3 of the Remark, "[i]f one skilled in the art combined the above two references, one would use ionizing sputtering *at a minimum*

temperature of <u>*350 °C*</u>", the examiner does not agree. The Corvasce et al. reference does not disclose *what method in what temperature used in the same process steps as instant claimed invention of forming lower layer of the lower-electrode conductive film* therefore the teaching of *forming/producing a titanium thin film by* sputtering at 200 °C and 300 °C of Sasaki et al. is used to make the combination in which reason and test for obviousness are provided. Further, the claim is not limited to any sputtering method.

9. In response to arguments on Ohwaki et al. and/or Matsuura et al. mainly on page 4 of the Remark, applicant is directed to the rejection which does not just apply the one condition of temperature but in reasoning with pressure and other parameters and following the previous combination of Sasaki et al. with Corvasce et al. Conditions to achieve the preferred (002) orientation are not the same triple conditions as alleged because "some content of water" (recited the same in instant claim 10) and the temperature are in the conditions of optimization among pressure and other parameters as taught by Ohwaki et al. Further, Matsuura et al.'s annealing step at 600 °C is not limited by the claim by use of "comprising" language. The fact that Matsuura et al.'s disclosure of the annealing at 600 °C <u>after</u> deposition of a Ti adhesion layer at room temperature not claimed is irrelevant.

10. It is agreed that claim 9 depends on claim 1 therefore it includes the limitations of claim 1. However, the limitation of claim 9 is "the insulating film is improved by exposing a surface of the insulating film to NH_3 plasma <u>before</u> the lower layer of the lower-electrode conductive is formed" without any indication of further limit(s); therefore any method that does not teach away the subsequent steps and that improves the quality of

the insulating film can be applied, and therefore the Noguchi et al. reference is used for this purpose.

11. The examiner does not agree with the closing statement "the unexpected results noted above should be sufficient to rebut any properly made prima-facie rejection for obviousness" because, in contra, if the obviousness rejection is not properly made, the unexpected results should be sufficient. In this instance, the rejections --provide the substantially same method of making a ferroelectric capacitor by the combination of Corvasce et al. and Sasaki et al. references, and in the crystal orientation(s) through optimization of Marsuura et al. and/or Ohwaki et al. references-- are proper to provide the same unexpected results; therefore, the rejections are not rebuttable in this aspect.

Conclusion

12. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh V. Pham whose telephone number is 571-272-1866. The examiner can normally be reached on M-Th (6:30-5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on 571-272-1907. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

TVP
06/22/2006

George Fourson
Primary Examiner